

A semi-empirical method of...

S/861/62/000/000/004/022  
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$$A_1 = \frac{A}{E} = \sin \pi \alpha - \frac{2\pi}{L} (P \sin \pi \alpha + Q \cos \pi \alpha). \quad (4),$$

$$P = \int_0^L \Phi(\xi) \sin \frac{2\pi\xi}{L} d\xi; \quad Q = \int_0^L \Phi(\xi) \cos \frac{2\pi\xi}{L} d\xi. \quad (4a),$$

$$B_1 = \frac{B}{E} = \cos \pi \alpha - \frac{2\pi}{L} (P \cos \pi \alpha - Q \sin \pi \alpha). \quad (5),$$

where  $\vec{E} = (1/L_n) \int E_z dz$ . The experimental results for  $L$  in the interval  $L = 12 - 56$  are described well by  $P = 0.694 + 0.592 \cdot 10^{-1} \cdot L$ ;  $Q = -0.272 + 0.118L - 0.248 \cdot 10^{-3} \cdot L^2$ . The maximum permissible phase  $\beta_{s-max}$  can be derived from

$$\lg \beta_{s-max} = \frac{\frac{E_\phi}{E} \sin(\beta_{rp} + \alpha\pi)}{2\pi G_n + \frac{E_\phi}{E} \cos(\beta_{rp} + \alpha\pi)}. \quad (12)$$

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with the aid of

$$\frac{\beta_{s_n}}{\beta_{s_1}} \sim \frac{A_n^\phi}{A_1^\phi} = \frac{L_1}{L_n} \sqrt{\frac{L_n G_1 \sin \beta_{s_1}}{L_1 G_n \sin \beta_{s_n}}}$$

For  $\beta_{s_1} = 20^\circ$ ,  $L_1 = 16$  cm and  $\bar{E} = 1.2 \cdot 10^4$  v/cm, the total length of the shielding tubes is found:  $L = 1447.5$  cm. The dependence of  $L$  of the periods on their number  $n$  is nearly linear. This paper was written in 1948. There are 14 figures.

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24.6720

AUTHORS: Akhiyezer, A. I., Lyubarskiy, G. Ya., Pargamanik, L. E.,  
Faynberg, Ya. B.

TITLE: Prebunching and dynamics of a proton bunch in a linear  
accelerator

SOURCE: Teoriya i raschet lineynykh uskoriteley; sbornik statey. Fiz.-  
tekhn. inst. AN USSR. Ed. by T. V. Kukoleva. Moscow,  
Gosatomizdat, 1962, 114 - 130

TEXT: It is shown that a linear accelerator can have a low injection energy  
of  $\sim 0.5$  Mev whilst furnishing large currents of  $\sim 10$  to 50 ma. When the  
mean accelerating field strength is 20 kv/cm a focusing magnetic field of  
15,000 oe is needed in the initial part of the accelerator. This focusing  
field becomes rapidly weaker with increasing particle energy. The efficien-  
cy of ion capture is increased by elystron bunching. When particles in a  
bunch that was originally homogeneous in velocity and density pass along a  
segment under an rf field, and immediately afterwards through a field-free  
drive segment, they are accelerated at different rates and form bunches of  
charge density. The preaccelerated particles must enter the accelerator at  
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the focus  $X_1 = v_0 / \omega$ .  $\alpha = eU / mv_0^2$ .  $U \sin \omega \tau$  is the modulated voltage applied to the acceleration segment,  $\tau$  the instant when the particle enters the segment, and  $v_0$  the initial velocity of the particle in the bunch. The greater the angular width of the group of particles, the tighter the bunch is pinched on Flystron bunching. If  $\Delta v_0$  is the initial velocity spread, then the phase range covered after bunching by particles entering the buncher with a velocity of  $v_0 + \Delta v_0$  in the phase range  $2\psi_0$  is

$$\phi = 2\psi_0 (1 - (\sin \psi_0 / \psi_0) (1 - 3\Delta v / v_0)).$$

The effective accelerating field on the accelerator axis can be undesirably attenuated by unequal attenuations of the fields on the axis and on the periphery of the gaps and also by a shift of the field into the drive tube. Long narrow tubes screen considerably better than short wide tubes. According to experimental studies in the Institut khimicheskoy fiziki AN SSSR (Institute of Chemical Physics AS USSR), the mean value of the electric field strength on the axis remains constant when the gap between the drive tubes is varied, and it increases slightly when the outer diameter of the drive tubes is increased. The problem of multiple gaps cannot be solved from the data available at present. The decreases in the depth of the potential well and in the angle of

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incidence, induced by space charge, are calculated on the basis of the model of an ellipsoidal bunch with slowly changing dimensions. Stable equilibrium corresponds to the synchronous particle phase  $\varphi = \varphi_s$ . In that model the focusing magnetic field reads

$$\left(\frac{H}{E}\right)^2 = \frac{mc^2}{eE\lambda} \left\{ \frac{mc^2}{eE\lambda} \left( 4\pi \frac{\Omega}{\omega} \right)^2 + 4\pi \frac{V\sqrt{1-\beta^2}}{\beta^2} \sin \varphi_s + \right. \\ \left. + \frac{6J}{eE} \left( \frac{\lambda}{R} \right)^2 (1-k) \right\}, \quad (4.1).$$

$\omega = 2\pi c/\lambda$  is the frequency of the r-f field,  $\Omega$  the frequency of the radial oscillations. The magnetic fields needed for injection energies of 0.5, 18.75, 145 and 350 Mev are 14.5, 7.6, 6.2 and 5.9 koe. The values  $\Delta\beta/\beta = 2\%$  for the initial relative velocity spread in the bunch, and  $\alpha = 2.2 \cdot 10^{-2}$  for the modulation factor of the buncher are obtained. There are 9 figures.

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24.6/30  
AUTHORS:

Akhiyezer, A. I., Lyubarskiy, G. Ya., Faynberg, Ya. B.

TITLE:

Electron counterflow focusing in a proton accelerator

SOURCE:

Teoriya i raschet lineynykh uskoriteley; sbornik statey. Fiz.-tekhn. inst. AN USSR. Ed. by T. V. Kukoleva. Moscow, Gosatomizdat, 1962, 131 - 146

TEXT: A theory is developed on counterflow focusing of a proton bunch (Nature, 168, 782, 1951). Radial focusing is achieved by the electrostatic field of the electron beam, which has to be stronger than the defocusing r-f field. Furthermore, the scattering of the electrons from the background gas is studied, taking space charge into account. The minimum amperage of the bunch is  $j_{\min} = (1/2)(vE/\beta\lambda)\sin\varphi_s$ .  $v$  is the electron velocity averaged over the period of the r-f oscillations,  $\varphi_s$  the synchronous phase,  $\beta$  the proton velocity, and  $\lambda$  the wavelength of the r-f field. The h-f field of the accelerator is taken to be a traveling wave of amplitude  $E_0$ , frequency  $\omega$  and wave vector  $k(z)$ . The canonical variables  $Q$  and  $P$  are introduced:  
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$$Q = \frac{\partial f}{\partial P} = \left( \frac{2u}{av_0} - t \right) \omega, \quad p = \frac{\partial f}{\partial z} = \frac{\omega P}{v_0 u}, \quad \text{where } f = P\omega \left( \frac{2u}{av_0} - t \right). \quad \text{Then}$$

$$\Delta H_1 = \frac{1}{\omega} \int_0^{2\pi} \frac{dH_1}{dt} \frac{dQ}{\frac{v_{\pi}}{uv_0} - 1} \quad (1.15),$$

if  $H_1 = H + \frac{\partial f}{\partial t}$  and  $\frac{dH_1}{dt} = \frac{\partial H_1}{\partial t}$ ,  $\Delta H_1$  is the change of  $H_1$  during a period during which  $Q$  changes by  $2\pi$ .  $u = (1 + \alpha z)^{1/2}$ ,  $\alpha = 2eE \cos \varphi_s / Mv_0^2 > 0$ , and  $v_0$  is the injection velocity of the protons. When  $E = 18$  kv/cm,  $v_0 = 3.3 \cdot 10^{-2} c$ ,  $\varphi_s = 20^\circ$  and  $\lambda = 150$  cm,  $H_1$  increases nearly linearly with  $H_0$ . The larger  $\beta$ , the larger  $H_1$ .  $\Delta H_1 / H_1 \approx 10^{-2}$  holds in the initial stage of the motion of the electron. The greater the velocity of the electrons in the bunch, the greater must be the density of the electron bunch needed for focusing. The total amperages under the present conditions at injection energies ( $mc^2(\epsilon - 1)$ ) of 1, 10, 50, 70 and 90 kev are 3.5, 1.9, 1.2, 1.06 and 0.7 a. S. Chandrasekhar's methods give

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$$\overline{\Delta x^2} = \frac{4\pi N Z^2 e^4}{m^2} \int_0^l [\psi_1^2(r-l) + \psi_2^2(r-l)] \frac{1}{v} \ln \frac{a_0 m v^4}{2 Z^2 e^4} d\tau. \quad (3.13)$$

for the mean square deviation of the electrons from the accelerator axis. N is the number of gas atoms per cm<sup>3</sup>, Z the nuclear charge and  $a_0 = 0.53 \cdot 10^{-3}$  cm. For  $\sqrt{\Delta x^2} < 10^{-2}$  cm, the magnetic field must be greater than 645 gauss. The effect of collisions on bunch broadening is completely compensated by increasing the magnetic field by 10 to 20 gauss. The significant divergence of the bunch as a result of space-charge repulsion is not impeded by this slight increase in field strength. This paper was written in 1953. There are 1 figure and 4 tables.

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24. 1730

AUTHORS: Lyubarskiy, G. Ya., Pargamanik, L. E.

TITLE: On the compatible oscillations of the accelerating field in linear accelerators

SOURCE: Teoriya i raschet lineynykh uskoriteley, sbornik statey. Fiz.-tekhn. inst. AN USSR. Ed. by T. V. Kukoleva. Moscow, Gosatomizdat, 1962, 147 - 150

TEXT: It is shown that the reductions

$$\frac{\Delta E}{E} = \frac{1}{2} \varphi_s^2 \frac{1 - \left(\frac{\kappa'}{\kappa}\right)^2}{1 - \left(\frac{\kappa'}{\kappa}\right)^2 \frac{\varphi_s^2}{2}} \quad (7)$$

(caused by power oscillations of the feeding generator) are still compatible with the stable motions of accelerated electrons in linear accelerators.  $\kappa \approx \varphi_s$  and  $\kappa' = \arccos((E/E') \cos \varphi_s)$ . E is the calculated mean value of the

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accelerating field and  $\varphi_s$  is the synchronous phase.  $E'$  and  $\varphi'_s$  are the corresponding parameters for the varied motions in the same accelerating system. The electrons are assumed to gain the energy  $\delta\epsilon = eEL\cos\varphi_s$  in each period of the accelerator. The final energy of the electrons is assumed to be considerably higher than their rest energy.  $L$  is the length of the investigated period. The requirement of synchronism does not impose any limitations upon the increase of the accelerating field. In the absence of focusing, the increase of the beam radius is given by

$$r = r_0 + \theta(\epsilon_0/eE \cos\varphi_s) \ln(\epsilon/\epsilon_0).$$
  $r_0$  and  $\theta$  are the initial radius and the angle of divergence of the beam,  $\epsilon_0$  and  $\epsilon$  are the initial and the final energy. This case corresponds to high electron energies (at least some Mev). Focusing with the aid of a magnetic field is essential in the initial stage of acceleration (up to energies of 2 - 5 Mev). The tolerable increase of the accelerating field increases with the focusing magnetic field. The defocusing effect of the increase  $\Delta E$  of the accelerating field can be compensated by the increase  $\Delta H/H = (1/2)(H_{lim}/H)^2(\Delta E/E)\sin\varphi_s$  of the magnetic field. This paper was written in 1951.

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11879

S/861/62/000/000/010/022  
B125/B102

26.2316  
AUTHORS: Rozentsveyg, L. N. (Deceased), Lyubarskiy, G. Ya.

TITLE: On the generation and acceleration of multicharged ions in a standing-wave linear accelerator

SOURCE: Teoriya i raschet lineynykh uskoriteley; sbornik statey. Fiz.-tekh. inst. AN USSR. Ed. by T. V. Kukoleva. Moscow, Gosatomizdat, 1962, 151 - 160

TEXT: The stripping (during passage through a layer of matter) and acceleration of multicharged ions of light elements (C, N, O) with the aid of a standing-wave linear accelerator is discussed. A 20-Mev proton accelerator of this type was built in the Fiziko-tekhnicheskiy institut AN USSR (Physico-technical Institute AS UkrSSR). The protons are injected by an electrostatic 1.7-Mv generator ( $\beta = 0.06$ ). In the present investigations, however, more advantageous accelerators (with injection energies of 400 - 600 and significantly stronger ion currents) are used. Singly charged  $O^{16}$  ions are accelerated to 7-8 Mev in the initial part, and to 100 Mev in the principal part. The first stripping is possible only after the ions have abandoned

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the initial section. An additional stripping is disadvantageous as the ion current (also in pulsed operation) is limited by the melting temperature of the foil. An additional stripping between initial and principal section is impossible for reasons connected with vacuum technique. For universal acceleration of  $C^{12}$ ,  $N^{14}$  and  $O^{16}$  ions without essential variations of the accelerating system, it is necessary to avoid the stripping of N and O ions of up to  $Z_{eff} > 6$ . The frequencies and the cophasal parameters of the accelerating field should be adjusted accordingly. From the above considerations, a standing-wave accelerator with the following principal parts is suggested: (1) Pulsed injection of singly charged ions by means of a device of 400 - 600 kv; (2) High frequency injection with the aid of a linear accelerator (energy 7 - 8 Mev, length 5 m). (3) The singly charged ions pass through a gas or a vapor jet in the stripping chamber and leave it as quintuply charged ions. These ions are then accelerated to 100 - 150 Mev in the principal accelerating section (linear accelerator with a length of ~10 m). The present paper was written in 1953. There are 5 figures and 1 table.

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39016

16.3400

S/140/62/000/004/005/009  
C111/C333

AUTHORS: Krasnosel'skiy, M. A. Lyubarskiy, G. Ya.  
TITLE: On the transition solutions of non-linear equations  
PERIODICAL: Vysshiye uchebnyye zavedeniya. Izvestiya. Matematika,  
no. 4, 1962, 81-85  
TEXT: As a transition solution of the equation

$$P\left(\frac{d}{dx}\right) y + f(y) = 0 \quad (A)$$

where  $P(v)$  is a polynomial of  $n$ -th ( $n \geq 2$ ) order, one denotes every solution  $y(x)$  for which there exist the finite limits

$$y_- = \lim_{x \rightarrow -\infty} y(x), \quad y_+ = \lim_{x \rightarrow +\infty} y(x) \quad (1)$$

where  $\lim_{x \rightarrow \pm\infty} y^{(k)}(x) = 0$  ( $k = 1, 2, \dots, n$ ). One investigates the existence and the uniqueness of the transition solutions of (A).

One supposes:  $y_- < 0$ ,  $y_+ > 0$ ; all zeros of  $P(v)$  are real and single;

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$f(y)$  is continuous on  $[q_1, 0]$  and  $[0, q_2]$ ; there exist  $m_- > 0$  and  $m_+ < 0$  such that

$$\frac{f(y_2) - f(y_1)}{y_2 - y_1} \begin{cases} < m_-, q_1 \leq y_1 < y_2 < 0, \\ > m_+, 0 < y_1 < y_2 \leq q_2; \end{cases}$$

$P'(0) \leq 0$ ,  $f(0) > 0$ ,  $f(q_1) = f(q_2) = 0$ ; all zeros of  $P(y) + m_{\pm}$  are real

and single. Let  $S$  be the set of the functions  $\omega(x)$  which on  $[-\infty, 0]$  and  $[0, \infty]$  are continuous, satisfying  $x\omega(x) \geq 0$  ( $-\infty < x < \infty$ ). Let  $S_0$  be the set of those  $\omega(x) \in S$  which in addition satisfy

$$q_1 \leq \omega(x) \leq q_2, \quad -\infty < x < \infty \quad (2).$$

Let  $a_- > m_-$  and  $a_+ < m_+$  be such that the zeros of  $P(y) + a_{\pm}$  are real and single and let  $a_{-q_1} = a_{+q_2}$ . If there denotes

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On the transition solutions of . . .

$$a(y) = \begin{cases} a_-, & y < 0, \\ a_+, & y \geq 0, \end{cases} \quad \varphi(y) = ya(y) - f(y)$$

then (A) can be written down in the form

$$P\left(\frac{d}{dx}\right)y + a(x)y = \varphi(y). \quad (3)$$

Let  $K(x,s)$  be the Green function of the operator  $P\left(\frac{d}{dx}\right) + a(x)$ . Under the suppositions above made one proves by aid of an operator  $H$  which maps  $S_0$  onto  $S_0$  where only the transition solutions of (A) are transformed into themselves:

Theorem of existence: Let  $f(y)$  be only positive in  $a_1 < y < b_1$  and  $b_2 < y < a_2$  ( $b_1 < 0 < b_2$ ). If

$$\min_{a_1 \leq y \leq b_1} \frac{y}{\varphi(y)} < \lim_{x \rightarrow -\infty} \int_{-\infty}^0 K(x, x+s) ds, \quad (6)$$

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$$\min_{b_2 \leq y \leq q_2} \left| \frac{y}{\varphi(y)} \right| < \lim_{x \rightarrow +\infty} \left| \int_0^{\infty} K(x, x+s) ds \right| \quad (6)$$

is satisfied, then (A) possesses at least one transition solution, for which there is  $y(-\infty) = q_1$  and  $y(+\infty) = q_2$ .

Theorem of uniqueness: If  $f(y) = ky$  has at most one solution on  $q_1 < y < q_2$  for all  $k$ , then (A) possesses in  $S_0$  a unique transition solution  $y(\bar{x})$ .

ASSOCIATION: Voronezhskiy gosudarstvennyy universitet (Voronezh State University)  
Ukrainskiy fiziko-tehnicheskii institut AN USSR  
(Ukrainian Physicotechnical Institute of the Academy of Sciences of the Ukr SSR)

SUBMITTED: July 10, 1961

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16.3400

33632  
S/042/62/017/001/002/005  
B112/B108

AUTHOR: Lyubarskiy, G. Ya.  
TITLE: Solutions of the "smoothened shock wave" type in non-linear equations

PERIODICAL: Uspekhi matematicheskikh nauk, v. 17, no. 1 (103), 1962, 183-189

TEXT: A solution of the boundary value problem

$$a_n y^{(n)} + a_{n-1} y^{(n-1)} + \dots + a_1 y' + f(y) = 0, \quad a_n = \pm 1, \quad (1.1)$$

$y(-\infty) = 0, y(+\infty) = 1, 0 < y(x) < 1 (-\infty < x < +\infty)$ ,  
where  $f(y)$  is continuous in the interval  $(0,1)$ ,  $f(0) = f(1) = 0$ ,  
 $f(y) > 0$  ( $0 < y < 1$ ), is said to be of the balanced shock wave type. In this paper, some sufficient conditions of existence and uniqueness of such solutions are derived. The condition  $a_1 < 0$  is necessary and sufficient.

The proofs are based on the following method: reduction of Eq. (1.1) to an integral equation and solution of this integral equation by iteration.

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Solutions of the "smoothened...

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N. I. Akhiezer, V. F. D'yachenko, I. M. Gel'fand, M. G. Kreyn, and I. M. Lifshits are thanked for assistance. There are 3 references: 1 Soviet and 2 non-Soviet. X

SUBMITTED: May 7, 1960

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38090

S/040/62/026/003/013/020  
D407/D301

24.4300  
10.1410

AUTHOR: Lyubarskiy, G.Ya. (Khar'kov)

TITLE: On the existence of weak shock-waves

PERIODICAL: Prikladnaya matematika i mekhanika, v. 26, no. 3,  
1962, 511 - 519

TEXT: Dissipative systems of nonlinear equations are considered. The equations of magnetohydrodynamics and hydrodynamics, in which dissipative processes are taken into account, are particular cases of such systems. The following proposition holds for dissipative systems (which are defined below): To each discontinuous solution of the system corresponds a shock wave if a) the jump of the discontinuous solution is stable with respect to splitting, b) the velocity  $U$  of the jump is near enough to one of the ordinary phase-velocities and c) the jump is small enough. Hence follows the existence, in magnetohydrodynamics, of sufficiently weak slow and fast shocks, regardless of the dissipation coefficients. This statement is based on a theorem about the necessary conditions for the existence of transitional solutions (defined by the author in the introduction) to the

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On the existence of weak shock-waves  
system of equations

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$$a_m y^{(m)} + \dots + a_1 y' + \varepsilon \beta_0 (y - y^2) = \varepsilon \sum_{k=1}^{m-1} y^{(k)} \varphi_k(y, y', \dots, y^{(m-1)}, \xi; \varepsilon) + \varepsilon^2 F_1(y, y', \dots, y^{(m-1)}, \xi; \varepsilon) \quad (1.1) \quad (1.1) \quad \checkmark$$

$$\xi_i' - \sum_{k=2}^m b_{ik} \xi_k = f_i(y) + \varepsilon P_i(y, \xi; \varepsilon) \quad (i=2, 3, \dots, m)$$

$$\xi_i = f_i(y) + \varepsilon F_i(y, \xi; \varepsilon) \quad (i=m+1, \dots, n)$$

Dissipative systems in magneto and ordinary hydrodynamics are defined as systems with asymptotically stable solutions (with respect to small perturbations of the initial state). Ideal systems are also defined. The phase velocity  $V$  is called ordinary, if it satisfies certain conditions. Further, a system is considered which determines the structure of the shock wave; the system of equations which describes the stationary shock-wave  $u(x, t)$ , is transformed, by introducing the notation  $B(u) = b(u) - V(u_-) a(u)$ , and the operators  $P_1$  and  $Q_1$ . Thereupon one obtains

$$-\varepsilon Q_1 a(u) + Q_1 B(u) = 0 \quad (4.3)$$

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$$\frac{d}{dx} \{-\varepsilon P_1 a(u) + P_1 B(u)\} = R(u) - \varepsilon Q_1 a(u) \quad (R = Q_1 B + c). \quad (4.4)$$

It is shown that system (4.4) has a transitional solution, and that the velocity  $U$  is close to the ordinary phase-velocity. Further, system (4.3) (4.4) is brought to a form, which is a particular case of system (1.1), and satisfies all the conditions of the above theorem. Thus, the initial statement has been proved, in particular the existence of structure in slow- and fast magnetohydrodynamic shock-waves which are weak.

SUBMITTED: February 12, 1962

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16.3400

S/038/62/026/004/001/002  
B112/B104

AUTHORS: Kreyn, M. G., and Lyubarskiy, G. Ya.

TITLE: Analytical properties of multipliers to periodic canonical differential systems of a positive type

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya matematicheskaya, v. 26, no. 4, 1962, 549-572

TEXT: The canonical system of differential equations  $dx/dt = J(H_0(t) + \lambda H_1(t))x$  (A) is considered. The matrices  $H_0$  and  $H_1$  are assumed to be periodic with the period  $T$ . The eigenvalues of the monodromy matrix of the system (A) are called multipliers of (A). Their analytical dependence on the parameter  $\lambda$  is investigated by applying the perturbation theory of selfadjoint operators as in a previous paper by these authors (Prikladnaya matematika i mekhanika, v. 25, no. 1 (1961), 24 - 37).

SUBMITTED: January 25, 1961

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LYUBARSKIY, G.Ya.

Solutions of the type of the "smoothed shock wave" in nonlinear  
equations. Usp.mat.nauk 17 no.1:183-189 Ja-F '62. (MIRA 15:3)  
(Differential equations)

8/781/62/000/000/015/036

**AUTHOR:** Lyubarskiy, G. Ya., Faynberg, Ya. B.

**TITLE:** Determination of the partition function of a plasma from the rate of propagation of longitudinal waves

**PERIODICAL:** Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady i konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 72-75.

**TEXT:** It is shown how to calculate the partition function of electrons in a plasma by measuring the phase and group velocities of the longitudinal waves in the plasma. It is assumed that paired collisions can be neglected. The partition function of a plasma determines many of its physical properties, so that any method of determining this function experimentally is of interest.

L. D. Landau has shown that strictly speaking there is no dispersion equation for longitudinal waves, but asymptotically (i.e., for large values of the time), any small perturbation is

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Determination of the partition function of a . . .

a superposition of a series of plane damped waves, and

$$1 + \frac{4\pi e^2}{mk^2} \int \frac{f_0(u) du}{V_0 - u} = 0, \quad (1)$$

where  $f_0(u)$  is the equilibrium partition function, can serve as an arbitrary "dispersion" equation. The integration in (1) is along the real axis from  $-\infty$  to  $+\infty$ , with the singularity  $V_{ph} = \omega/k$  of the integrand circuted from below.

If electronic longitudinal oscillations of specified frequency are excited in the plasma, a set of damped waves with complex  $k$  is produced, but at large distances only one such wave will remain and the others will be damped out. Measurement of the phase velocity of this wave as a function of the frequency yields experimentally the relationship

$$V_0 = V_0(k) \text{ или } k = k(V_0). \quad (2)$$

Once (2) is known, the partition function can be written in the form

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Determination of the partition function of a . . .

$$f_0(u) = f_0(u_0) - \frac{m}{2\pi\epsilon^2} \int_{-\infty}^{\infty} \frac{k_0(V_0)\epsilon_0(V_0)}{1 - \frac{V_0}{V_{gr}(V_0)}} dV_0 \quad (3)$$

where  $k_0(V_{ph})$  and  $\epsilon(V_{ph})$  are the real and imaginary parts of the wave vector  $k$  corresponding to the real frequency  $\omega$ ,  $V_{ph} = \omega/k_0$ , and  $V_{gr} = d\omega/dk_0$  is the group velocity.

There are no references.

Card 3/3

S/781/62/000/000/016/036

AUTHORS: Akhiezer, A. I., Lyubarskiy, G. Ya., Polovin R. V.

TITLE: Evolutional discontinuities in magnetohydrodynamics

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tekh. inst. AN.Ukr.SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 76-79

TEXT: Evolutionality conditions of magnetohydrodynamic shock waves with respect to perturbations that propagate perpendicularly to the discontinuity surface were derived by Akhiezer, Lyubarskiy, and Polovin (ref. 2: ZhETF, 35, 731 (1958)) and their stability under small general perturbations (propagating at arbitrary angle to the discontinuity surface) was demonstrated by V. M. Kontorovich (ref. 3: ZhETF, 35, 1216, 1968). In the present article Kontorovich's results are derived in a simple manner, wherein the arbitrary disturbance is expanded in a Fourier integral in the transverse dimension and is assumed small over a sufficiently short time interval, so that the magnetohydrodynamic equations can be linearized. It is demonstrated that to determine the evolutionality con-

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Evolutional discontinuities ....

S/781/62/000/000/016/036

ditions it is sufficient to consider plane waves propagating perpendicular to the discontinuity surface. In particular, in the region  $U_{1x} < v_{1x} < U_{1+}$ ,  $U_{2-} < v_{2x} < U_{2x}$  the shock wave is not evolutional. Here

$$U_+ = \sqrt{\frac{U^2 + c^2 + \sqrt{(U^2 + c^2)^2 - 4c^2U_x^2}}{2}}; U = H/\sqrt{4\pi\rho}$$

and  $c$  is the velocity of sound. It follows therefore that there exist two types of shock waves, a slow one for which  $U_{1-} < v_{1x} < U_{1x}$ ;  $v_{2x} < U_{2-}$  and a fast one for which  $U_{1+} < v_{1x}$ ;  $U_{2x} < v_{2x} < U_{2+}$ . It follows from the foregoing two inequalities that if the shock waves of the same type follow each other, the rear wave will overtake the front wave. As to waves of different types, an Alfvén discontinuity will overtake a slow shock wave or a slow magnetic-sound weak discontinuity, while a fast shock wave will overtake all types of discontinuities. Nonevolutionary shock waves cannot result from either continuous or discontinuous solutions. They can exist only for an instant either upon collision of two evolutionary discontinuities, or as discontinuities in the initial conditions. The resultant nonevolutional discontinuity immediately splits into shock and self-similar waves, although all boundary conditions are satisfied on such a discon-

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Evolutional discontinuities ...

S/781/62/000/000/016/036

tinuity and the entropy can increase. An example of such a splitting was considered by Lyubarskiy and Polovin (ref. 5: ZhETF 36, 1272, 1959).

Card 3/3

S/781/62/000/000/018/036

AUTHOR: Lyubarskiy, G. Ya.

TITLE: Contribution to the kinetic theory of shock waves

SOURCE: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tekh. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 82-85.

TEXT: An attempt is made to investigate the behavior of shock waves with allowance for the finite mean free path, i.e., on the basis of a kinetic equation containing the collision integral. The study concerns the simple case when the medium in which the shock wave propagates is a monatomic neutral perfect gas and the shock wave is plane and stationary. It is shown that the formulas obtained from the kinetic equation agree quite well with those obtained from the hydrodynamic analysis with allowance for the dissipative processes, when the distances are not very large ( $|x| \ll \tau c(M - 1)^{-3}$ , where  $x$  is the propagation direction,  $\tau$  the relaxation time,  $c$  the velocity of sound, and  $M$  the Mach number). At very large distances the kinetic analysis leads to a slower attenuation of the shock wave than the hydrodynamic analysis.

Card 1/1

S/044/63/000/002/015/050  
A060/A126

AUTHOR: Lyubarskiy, G.Ya.

TITLE: On the existence of transient solutions of certain nonlinear equations

PERIODICAL: Referativnyy zhurnal, Matematika, no. 2, 1963, 40, abstract 2B174  
(Uch. zap. Khar'kovsk. un-t, 1961, 120, Zap. Mekhan.-matem. fak. 1  
Khar'kovsk. matem. o-va, v. 28, 5 - 22)

TEXT: The author studies transient solutions of the equation

$$P_0 \left( \frac{d}{dx} \right) y + f(z) = 0, \quad z = Q \left( \frac{d}{dx} \right) y, \quad (1)$$

where  $P_0(v)$  and  $Q(v)$  are certain polynomials, and  $f(z)$  is a continuous non-negative function. These solutions satisfy the conditions:  $y(x) \neq \text{const}$ ,

$$\lim_{x \rightarrow -\infty} y(x) = y_-, \quad \lim_{x \rightarrow +\infty} y(x) = y_+, \quad \lim_{x \rightarrow \pm\infty} y^{(k)}(x) = 0$$

$$(k = 1, \dots, n),$$

where  $n$  is the degree of the polynomial  $P_0(v)$ . It is assumed that  $Q(0) = 1$ ,

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On the existence of transient solutions of ....

S/044/63/000/002/015/050  
A060/A126

$P_0(0) = 0$ , and that  $f(z)$  has only isolated zeros. Then for a transient solution to exist it is necessary that  $P'_0(0)[y_- - y_+] > 0$ . In what follows it is assumed that  $y_- = 0$ ,  $y_+ = 1$ ,  $P'_0(0) < 0$  and also that all the roots of the polynomial  $P_0(v)$  are real and simple. The following results are obtained. Let  $y(x)$  be some bounded solution of equation (1) and such that the function  $z(x)$  is also bounded. Then  $y(x)$  is a monotonically increasing function. In the presence of certain constraints upon the polynomial  $Q(v)$  (in particular, its degree should be less than  $n - 1$ ) it is demonstrated that in that case the function  $z(x)$  is also monotonically increasing, and  $y(x)$  is a transient solution. The number of inflection points of the curve forming the transient solution  $y(x)$  does not exceed the number of extrema of the function  $f(z)$  on the interval  $0 \leq z \leq 1$ . For proving the existence of the transient solution the author sets up an integral equation which is then solved by the method of successive approximations. The sufficient conditions for the uniqueness of the transient solution satisfying the condition  $z(0) = c$  are also indicated. This paper is the continuation of two other papers by the author (RZhMat, 1962, 5B222; 10B163).

Yu.A. Klovov

[Abstracter's note: Complete translation]

Card 2/2



S/781/62/000/000/017/036.

AUTHORS: Lyubarskiy G. Ya., Polovin R. V.

TITLE: Contribution to the theory of simple waves

SOURCE: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktisy. Fiz.-tekh. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR. 1962. 79-82

TEXT:

Simple waves are defined as solutions of the magnetohydrodynamic differential equations in a form such that all the quantities can be expressed as functions of one of them. Their importance to hydrodynamic or magnetohydrodynamic theory lies in the fact that they are the only ones that can border on the region of continuous flow if there are no shock waves. The differential equations themselves have been derived in various approximations by Chew, Goldberger, and Low (ref. 1: Proc. Royal Soc. A236, 112, 1956) and others. It is shown that a region of continuous flow can border in magnetohydrodynamics only on a strong discontinuity or a simple wave. Although there exist proofs of this statement for ordinar

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Contribution to the theory of simple waves

S/781/62/000/000/017/036

hydrodynamics (two variables), as for example in the book by Courant and Friedrichs (ref. 3: Supersonic Flow and Shock Waves, Interscience, 1948), there is no such proof for more than two variables. The proof is based on the fact that the approximate differential equations for the plasma are hyperbolic, and the correspondence existing between the characteristics of the equations and the simple waves. This leads to a system of ordinary differential equations, which can be integrated. The integrability is demonstrated by proving a uniqueness theorem that has much in common with the theorem given by Friedrichs (ref. 5: Am. J. Math. 70, 555, 1948). The three references in the text are the only non-Russian ones.

Card 2/2

KRASNOSEL'SKIY, M. A.; LYUBARSKIY, G. Ya.

Transitional solutions to nonlinear equations. Izv. vys.  
ucheb. zav.; mat. no.4:81-85 '62. (MIRA 15:10)

1. Voronezhskiy gosudarstvennyy universitet i Ukrainskiy  
fiziko-tekhnicheskoy institut AN UkrSSR.

(Differential equations)

LYUBARSKIY, G.Ya. (Khar'kov)

On the existence of shock waves of low intensity. Prikl. mat. i  
mekh. 26 no.3:511-519 My-Je '62. (MIRA 16:5)  
(Shock waves)

ACCESSION NR: AT4036052

8/2781/63/000/003/0151/0161

AUTHORS: Akhiezer, A. I.; Lyubarskiy, G. Ya.; Polovin, R. V.

TITLE: On the kinetic instability of a plasma

SOURCE: Konferentsiya po fizike plazmy\* i problemam upravlyayemogo termoyadernogo sinteza. 3d, Kharkov, 1962. Fizika plazmy\* i problemy\* upravlyayemogo termoyadernogo sinteza (Plasma physics and problems of controlled thermonuclear synthesis); doklady\* konferentsii, no. 3, Kiev, Izd-vo AN UkrSSR, 1963, 151-161.

TOPIC TAGS: plasma research, plasma instability, kinetic gas theory, distribution statistics, plasma stability, plasma magnetic field interaction, Laplace transformation

ABSTRACT: The article deals with the stability of the distribution function of particles in a plasma with respect to plasma oscillations. The general conditions for the stability of the electron distribution

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ACCESSION NR: AT4036052

function are derived by investigating the behavior of individual spatial Fourier components of the potential and the deviations of the electron distribution function from the initial distribution function. The first part of the analysis is devoted to a free plasma without external fields. The singular points of the Laplace transformations of the potential and of the distribution function (which determine the behavior of these functions in the steady state) are then determined. Stability criteria based on the locations of these roots in the complex plane are then established. It is shown that a distribution function which has only one maximum is stable; this confirms deductions made by others. Furthermore, an arbitrary spherically symmetrical distribution function which does not vanish anywhere is also stable, regardless of the number of maxima. The second part of the analysis is devoted to a plasma in a constant and homogeneous magnetic field, the stability being investigated only with respect to plasma waves for which the electric field is potential. The necessary and sufficient stability criteria are estab-

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ACCESSION NR: AT4036052

lished and it is shown that an even distribution function with a single maximum is stable and that any anisotropic distribution function is stable. The stability conditions for a fixed value of the plasma frequency are also established. The stability condition of the distribution function in a plasma in a constant and homogeneous weak electric field is then determined and it is shown that a weak electric field does not change the stability conditions. "The authors are grateful to K. N. Stepanov and A. B. Kitsenko for valuable advice, and to L. B. Landau and M. A. Leontovich for a useful discussion." Orig. art. has: 29 formulas.

ASSOCIATION: None

SUBMITTED: 00

DATE ACQ: 21May64

ENCL: 00

SUB CODE: ME

NR REF SOV: 013

OTHER: 014

Card 3/3

L 17238-63

BDS/FCC(w)/EWT(d)--AFFTC/IJP(C)

ACCESSION NR: AP3005660

S/0052/63/008/003/0309/0318

AUTHOR: Lyubarskiy, G. Ya.; Rabotnikov, Yu. L. (Kharkov)

TITLE: Theory of differential equations with random coefficients

SOURCE: Teoriya veroyatnostey i yeye primeneniya, v. 8, no. 3, 1963, 309-318

TOPIC TAGS: differential equation, random coefficient, bounded mean value

ABSTRACT: The equation  $\ddot{u}(t) + a_1(t)\dot{u}(t) + [a_0(t) - \alpha(t)]u(t) = 0$  is considered where the coefficients  $a_1(t)$  and  $a_0(t)$  are real, piecewise continuous and periodic functions with the same period  $T$  and  $\alpha(t)$  is a real random function. The restrictions on the  $\alpha(t)$  are essentially the following. The correlation length  $a$  is much shorter than the period  $T$ , the random function  $\alpha(t)$  ( $\omega < t < \omega + a$ ) does not exceed the value  $\gamma/\sqrt{a}$  ( $\gamma = \text{const} < 1$ ). Necessary and sufficient conditions are found for the boundedness of the mean values  $Mu^2(t)$ ,  $M[\dot{u}(t)\dot{u}(t)]$  and  $M\ddot{u}^2(t)$ . "The authors take this opportunity to thank A. I. Akhiezer for his advice concerning these problems and many helpful discussions." Orig. art. has: 30 formulas.

Card 1/1



LYUBARSKIY, G.Ya.

Boundary value problem on an axis for a nonlinear equation of the nth order. Dokl.AN SSSR 149 no.3:521-524 Dokl.AN SSSR 149 no.3:521-524 Mr '63. (MIRA 16:4)

1. Fiziko+tekhnicheskiy institut AN UkrSSR. Predstavleno akademikom S.L.Sobolevym.  
(Boundary value problems) (Equations)

I 45609-65 XVT(d) IJP(c)

ACCESSION NR: AF5008657

S/0044/65/000/001/B038/2038

SOURCE: Ref. zh. Matematika, Abs. IB171

AUTHOR: Lyubarskiy, G. Ya.

TITLE: On the theory of nonlinear equations with a small parameter

CITED SOURCE: Uch. zap. Khar'kovsk. un-t, v. 138, 1964, Zap. Mekhan.-matem. fak. i Khar'kovsk. matem. o-va, v. 30, 38-47

TOPIC TAGS: nonlinear differential equation, approximation method, boundary value problem

TRANSLATION: The following boundary value problem is studied:

$$\begin{aligned} c_n y^{(n)} + F(\epsilon y, y', \dots, y^{(n-1)} + \epsilon f(y) &= 0 \quad (c_n \neq 0), \\ y(-\infty) - q_1 < 0; \quad y(+\infty) - q_2 > 0, \quad y'(\pm \infty) &= \dots \\ \dots - y^{(n)}(\pm \infty) &= 0. \end{aligned}$$

On the assumption that the parameter  $\epsilon$  is small, conditions are formulated for the

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ACCESSION NR: AR5008657

existence and uniqueness of a solution. A method for the approximate solution of the problem is also suggested. Yu. Klovov.

SUB CODE: MA

ENCL: 00

Card 2/2 MB

LYUBARSKIY, G.Ya.

Transitional solutions to nonlinear equations. Prikl.metod.resch.  
diff.urav. no.2:85-98 '64. (MIRA 18:4)

L 3623-66 EWT(m)/EPA(w)-2/EWA(m)-2 IJP(c)

ACCESSION NR: AP5024025

UR/0057/65/035/009/1525/1531

AUTHOR: Bakay, A.J.; Lyubarskiy, G.Ya.; Rozhkov, V.V.

36  
B

TITLE: Asymptotic solution of a diffusion problem and its application to the theory of cyclic particle-storage devices

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 9, 1965, 1525-1531

TOPIC TAGS: particle motion, particle scatter, cyclic accelerator, physical diffusion, stochastic process, mathematic method, mathematic operator

ABSTRACT: The authors show largely by verbal arguments that if a system has an asymptotically stable orbit and is destroyed when its representative point crosses a certain closed surface in phase space, then under certain conditions its mean life time when it is subjected to stochastic forces can be calculated by finding the smallest eigenvalue and the corresponding eigenfunction of the Fokker-Planck-Kolmogorov operator that describes its motion. This method is employed to calculate the mean lifetime of a charged particle in a storage ring when it is subjected to stochastic forces arising from collisions with residual gas molecules and from the quantum nature of the radiation process. The equations for the radial and the

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L 3623-66

ACCESSION NR: AP5024025

phase oscillations are assumed to linear and the stochastic forces to be uncorrelated. The corresponding Fokker-Planck-Kolmogorov operator is derived and it is shown that the eigenvalue problem allows of separation of variables. The smallest eigenvalue and its eigenfunction are calculated by a perturbation method that depends on the damping constants in the equations of motion being large. Formulas are presented for the distribution of the accumulated particles and for the mean lifetime of a particle. Orig. art. has: 47 formulas.

ASSOCIATION: none

SUBMITTED: 17Oct64

ENCL: 00

SUB CODE: NP

NR REF SOV: 002

OTHER: 000

  
Card 2/2

LYUBARSKIY, I.G.

Method of turning curved sections of handrails on a lathe.  
Rats.i izobr.predl.v stroi. no.50:12-15 '53. (MLRA 7:2)  
(Handrailing) (Turning)

LYUBARSKIY, I.G., inzh.

Tubular and solid hinges for sashes with weather flanges.  
Nov.tekh. i pered. op. v stroi. 19 no.7:26 J1 '57. (MIRA 10:10)  
(Windows) (Hinges)



RAYKHMER, Moisey Yefremovich, prof.; GUBERMAN, Issak Davidovich, kand.  
tekhn.nauk; LYUBARSKIY, I.L., otv.red.; GOLUBYATNIKOVA, G.S.,  
red.isd-vs; PROZOROVSKAYA, V.L., tekhn.red.

[Principles for norm setting for material expenditures in coal  
mining] Osnovy normirovaniia raskhoda materialov v ugol'noi  
promyshlennosti. Moskva, Gos.nauchno-tekhn.isd-vo lit-ry po  
gornomu delu, 1960. 157 p. (MIRA 13:10)  
(Coal mines and mining--Equipment and supplies)

Phas composition of carburized layers of steel. I. S. Palatnik, I. M. Lyubarskii, A. P. Lyulchenko, and I. A. Tananko (V. I. Lenin Polytech. Inst. and A. M. Gor'kii State Univ., Kharkov). *Fiz. Metal. i Metalloved., Akad. Nauk S.S.S.R., Ural. Filial* 1, 500-54 (1955).—Specimens of steel contg. C 0.18, Cr 1.5, Ni 4.45, and W 1.02% were carburized at 910° for 16-17 hrs, producing a carburized zone 1.5 mm. thick. Carbides were removed from the carburized zone by electrolysis in 20% HCl soln. X-ray exam. of the carburized layer and chem. and spectrographic analysis of the carbides indicated the formation of carbides of the Fe<sub>3</sub>C and (Fe, Cr, W)<sub>3</sub>C<sub>4</sub> types. The latter contained Fe 54, Cr 7-10%, and W and C balance. No (Fe, Cr, W)<sub>3</sub>C<sub>4</sub> was formed on the surface; at a depth of 0.2-0.3 mm. it reached a max. of 4-5% and then decreased to 2-3% at increased depth. Residual austenite reached a max. of 50% at a depth of 0.3-0.5 mm. The formation of max. amts. of residual austenite and (Fe, Cr, W)<sub>3</sub>C<sub>4</sub> was due to intermediate transformations in the metastable system.

H. W. Rothmann

18 18  
Investigation of the process of sulfidization of steel.  
I. M. Lyubarskii, D. V. Voskoboynikov, Z. A. Shevchenko,  
and A. P. Lyubchenko. *Tekhn. Tsvetmet. Mashinostroyeniya* 1955, No. 2, 12-15; *Referat. Zhur., Met.* 1956.  
Abstr. No. 9034.---X-ray structural analysis and the method  
of active isotopes (irradiation of Cr), are best for examina-  
tion of sulfidized films, the depth of S penetration into metal,  
and the distribution of different sulfides according to the  
depth of layer. Diffusion of S into metal to a great depth  
during sulfidization increases. A. N. Pravon

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11

LYUBARSKIY, I. M.

Structure of the "white mass." L. B. Palstok, I. M. Lyubarskiy, and B. T. Boiko (V. I. Lenin Polytechnic and A. M. Gorkii State Univ. Kharkov). *Ukr. Khim. Zh.* 1956. 32: 1000-1001. (Ukrainian)

On the surface of heavily oxidized G-10, there is an oxidation-mechanism as well as the formation of a surface layer. The structure is described in the literature. The structure is described in the literature. The structure is described in the literature.

Lyubarskiy, I. M.  
21(8)

PHASE I BOOK EXPLOITATION

SOV/1764

Vsesoyuznaya nauchno-tehnicheskaya konferentsiya po primeneniyu radioaktivnykh i stabil'nykh izotopov i izlucheniye v narodnom khozyaystve i nauke Moscow, 1957.

Trudy... Mashinostroyeniye i priborostroyeniye (Transactions of the All-Union Conference on the Use of Radioactive and Stable Isotopes and Radiation in the National Economy and Science; Machine and Instrument Manufacturing) Moscow, Izd-vo AN SSSR, 1958. 358 p.  
4,500 copies printed.

Sponsoring Agencies: USSR. Glavnoye upravleniye po ispol'zovaniyu atomnoy energii, and Akademiya nauk SSSR.

Editorial Board of Set: V.I. Dikushin, Academician (Resp. Ed.), N.N. Shumilovskiy (Deputy Resp. Ed.), Yu. S. Zaslavskiy (Deputy Resp. Ed.), L.K. Tatochenko, B.I. Verkhovskiy, S.T. Nazarov, L.I. Petrenko, and N.G. Zelevinskaya (Secretary).

Ed. of Publishing House: P.N. Belyanin; Tech. Ed.: T.P. Polenova.

Card 1/ 20

Transactions of the All-Union Conference (Cont.) SOV/1764

**PURPOSE:** This book is intended for specialists in the field of machine and instrument manufacture who use radioactive isotopes in the study of materials and processes.

**COVERAGE:** This collection of papers covers a very wide field of the utilization of tracer methods in industrial research and control techniques. The topic of this volume is the use of radioisotopes in the machine- and instrument-manufacturing industry. The individual papers discuss the applications of radioisotope techniques in the study of metals and alloys, problems of friction and lubrication, metal cutting, engine performance, and defects in metals. Several papers are devoted to the use of radioisotopes in the automation of industrial processes, recording and measuring devices, quality control, flowmeters, level gauges, safety devices, radiation counters, etc. These papers represent contributions of various Soviet institutes and laboratories. They were published as Transactions of the All-Union Conference on the Use of Radioactive and Stable Isotopes and Radiation in the National Economy and Science, April 4-12, 1957. No personalities are mentioned. References are given at the end of most of the papers.

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Transactions of the All-Union Conference (Cont.)

SOV/1764

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Vaynshteyn, V.E., and Yu.M. Vinogradov (Institut mashinovedeniya AN SSSR - Institute of Mechanical Engineering, Academy of Sciences, USSR). Study of the Behavior of the Sulfidized Layer in Wear Processes 19

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Transactions of the All-Union Conference (Cont.)

SOV/1764

Zamcruyev, G.M., and Ya. N. Levin (Magnitogorskiy gornometallurgicheskiy institut imeni Nosova — Magnitogorsk Mining and Metallurgical Institute imeni Nosov). Study of Frictional and Wear Transfer of Metals 26

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Zavel'skiy, V.S., and K.S. Ramaya (Tsentral'nyy nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut—Central Scientific Research Institute for Automobiles and Automotive Engines). Study of the Effect of Oil Properties on the Wear of Iron 36

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Transactions of the All-Union Conference (Cont.)

SOV/1764

Nikitin, M.D. (Tsentral'nyy nauchno-issledovatel'skiy dizel'nyy institut - Diesel Research Institute). Effect of the Number of Re-  
volutions and Maximum Cycle Pressure on the Wear of Upper Piston  
Ring and Cylinder Sleeve in Diesels 43

Nisnevich, A.I. (Nauchno-issledovatel'skiy traktorny institut -  
Tractor Research Institute). Study of the Effect of Dust on the  
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Zaslavskiy, Yu. S., G.I. Shor, and I.A. Morozova (VNII po perera-  
botke nefi i gaza i polucheniyu iskusstvennogo zhidkogo topliva -  
All-Union Scientific Research Institute for the Processing of Pe-  
troleum and Gas and the Production of Synthetic Liquid Fuel).  
Reduction of the Low-temperature Wear of Cylinder-Piston Units in  
Engines by the Use of Oil Additives 52

Zaslavskiy, Yu.S., S.E. Kreyn, R.N. Shneyerova, and G.I. Shor  
(VNII po pererabotke nefi i gaza i polucheniyu iskusstvennogo  
zhidkogo topliva - All-Union Scientific Research Institute for  
the Processing of Petroleum and Gas and the Production of Synthetic

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Transactions of the All-Union Conference (Cont.)	SOV/1764
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LYUBARSKIY, I. M.  
LYUBARSKY, I. M.

"On the Structure and Wear Resistance of Case-Hardened Steel," L.S. Palatnik,  
I.M. Lyubarsky, A.P. Lyubchenko, Moscow, USSR

Paper presented for presentation at the International Conference on  
Radioisotopes in Scientific Research, Paris, 9-20 Sep 1957.

Moscow Aviation Inst, Min Higher Education, USSR

AUTHOR: ~~Lyubarskiy, I. Mr.~~, Candidate of Technical Sciences, 32-10-23/32  
Director of the Central Laboratory of the Locomotive Works imeni  
Malyshev in Khar'kov.

TITLE: Comments

PERIODICAL: Zavodskaya Laboratoriya, 1957, Vol 23, Nr 10, pp 1228-1229(USSR)

ABSTRACT: In his report on the occasion of the 40 th anniversary of the  
October revolution, the author states that nowadays an engineer  
specialized in the physics of metals and physical chemistry is  
equal in importance to a technical manager of a firm. On the  
strength of experience, the author further states that, according  
to his opinion, the analysis of the structure of X-rays belongs  
above all to a well managed mechanical engineering plant, for by  
means of this analysis the is able, e.g. to achieve the best pre-  
requisites for galvanic metal coatings, hard-nickel platings and  
the like and to create better conditions of cementation with va-  
rious kinds of thermal processing. Particularly practical results  
were at last achieved by the application of radioactive isotopes,  
as well as with electron microscopy at high temperatures. Accor-  
ding to the author, the method of gamma-rays was successfully  
applied in his works-laboratories for the control of cast cranks-  
hafts of a weight of ~ 2 tons, and for the control of welding

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32-10-23/32

Comments

seams. Test-methods with respect to the life of bearing-alloys and gear wheel-sets, and the investigations of the properties of lubricants, as well as corresponding examinations of component parts of engines with respect to cavitation-trouble, are applied. Further, it is asserted that approximately 70% of all analyses are carried out at present according to spectroscopic methods in this work-laboratory. Both the photocolorimetric and the complexometric methods, however, are equally successfully applied in this laboratory, as well as the electric measurement of voltage, the photoelastic determination of voltage, and various physico-chemical methods. Concluding, the author states that unfortunately by far not all achievements of Soviet sciences were practically applied in the industrial enterprises. This can be stated above all with respect to the insufficient investigation of the properties of the surface of machine component parts in the sense of adaption to service-conditions. A further perfection of the application of micromechanical investigations, micro-radiography of diffraction and absorption, and especially of microchemical X-ray analysis should lead to success. Moreover, the quantometric and carbidometric methods of determining the chemical composition of various sorts of steel, as well as ultrasonic methods in the process of production are too little applied in works-laboratories according to the opinion of the author. Much more attention

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Comments

should be paid to the use of various synthetic materials (like plastics, glass-ceramics, wooden plastics, etc.) in substitution for metals and care should be taken that the achievements of Soviet science should soon be practically and fully applied in Soviet industry.

ASSOCIATION: Tsentral'naya laboratoriya Khar'kovskogo teplovozostroitel'nogo zavoda im. Malysheva (Central Laboratory of the Khar'kov Locomotive Works im. Malyshev)

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SOV/137-58-8-17811

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 8, p 231 (USSR)

AUTHORS: Palatnik, L. S., Lyubarskiy, I. M., Lyubchenko, A. P.

TITLE: On the Formation of the Carburized-layer Structure in Steel (O formirovanii struktury tsementirovannogo sloya stali)

PERIODICAL: Uch. zap. Khar'kovsk. un-t, 1957, Nr 95 Tr. Khim. fak. i N. -i. in-ta khimii KhGU, Vol 18, pp 75-91

ABSTRACT: Investigations were performed in order to determine how the wear-resistant properties of steel 18KhNVA are affected by the structure of steel obtained as a result of various heat treatment procedures applied to the steel after carburization. The wear resistance (WR) was determined with the aid of radioactive isotopes on roller-shaped specimens 50 mm in diameter and 7 mm wide. The steel was rendered active by introduction of radioactive  $\text{Co}^{60}$  into molten metal. The active rollers operated in contact with three inactive rollers, 50 mm in diameter and 10 mm wide, mounted in a special stand which simulated the operation of a gear transmission. The extent of wear was determined by measurement of the radioactivity of the lubricant by means of a counter. In one revolution, the velocity of

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### On the Formation of the Carburized Layer Structure in Steel

sliding on the surface of a roller changed from  $-1$  to  $+1$  m/sec. It was established that quenching the metal in water or oil immediately after carburization greatly increases WR and resistance to pitting, as compared with the procedure in which the part is quenched and tempered at  $150^{\circ}\text{C}$  after the cementation pot had been cooled in air. The improvement in WR properties can not be explained by transformation of the retained austenite into martensite during the process of friction, because metallographic and X-ray analyses indicate that the amount of austenite present in the specimen is the same before and after the tests for wear. The WR is impaired as the content of retained austenite in the carburized layer is increased under slow cooling after carburization. Rapid cooling after carburization results in a considerable increase in WR. X-ray analysis of the substructure of austenite crystal lattice after slow and rapid cooling indicates that the lattice suffers a slight microdeformation if cooled abruptly from the carburization temperature; the solid solution exhibits a maximum of Cr and C saturation which determines the high WR of the carburized layer. A significant microdeformation of the crystal lattice occurs upon slow cooling. Slowly cooled austenite loses a good deal of its ability for deformation and hardening when resisting external forces. The results of the present work were verified on 6 and 10-mm thick gears with a module (reciprocal of pitch diameter) of 5 and a root-circle diameter

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On the Formation of the Carburized-layer Structure in Steel

of 100 mm. Quenching of the gears in water immediately after carburization increased their WR by a factor of 2.5. An explanation is given for the nature of the "white zone" which appears in a thin surface layer during friction, as well as under impact and in the course of hardening by shot peening.

N. K.

- |                                 |                         |
|---------------------------------|-------------------------|
| 1. Steel--Mechanical properties | 2. Steel--Carbonization |
| 3. Steel-- Structural analysis  | 4. Cobalt isotopes      |
| (Radioactive)--Applications     |                         |

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Lyubarskiy, I.M.

28(5)	PHASE I BOOK EXPLOITATION	SOV/2632
	<p>                     Akademiya nauk SSSR. Institut mashinovedeniya                      Treniya i imos v mashinakh; sbornik XII (Friction and Wear                      in Machines) Collection 12) Moscow, Izd-vo AN SSSR, 1958.                      354 p. Article slip inserted. 4,000 copies printed.                 </p> <p>                     Ed. I. M. M. Krushchev, Professor; Ed. of Publishing House:                      M.A. Babichev; Tech. Ed.: Ye.V. Zelenovskiy, Professor,                      Board; Ye.M. Gut'yar, Professor, A.B. Krasovskiy, Candidate of                      I.V. Kragelskiy, Professor, A.D. Krasovskiy, Candidate of Technical                      Sciences, I.Yu. Pruzhnikov, Professor, and M.M. Krushchev, Professor.                 </p> <p> <b>PURPOSE:</b> This book is intended for scientists, engineers, and                      technicians in the field of machine manufacture and operation,                      and for instructors in schools of higher education (vuzes).                 </p> <p> <b>COVERAGE:</b> This collection of articles presents the results                      of new investigations in the field of wear, friction, and                      lubrication. The subjects discussed include structural                      changes in the surface layer of metals in friction, the                      development of friction-brake materials, and theoretical                      investigations in the field of dry friction and friction                      with boundary and complete frictions. A bibliography of                      each article see the Table of Contents. A bibliography of                      Soviet and non-Soviet materials on friction, wear and lubri-                      cation for 1954-55 prepared by Ye.O. Vil'dt is included.                 </p>	181
	<p>                     Golubev, A.I. Effect of Heat on Fluid Friction in the Non-                      loaded Lubricating Film                      The author presents the results of an experiment                      to determine the lubricating film-boundary temperature                      in a coaxially arranged shaft and bushing lubricated                      clearances and using two types of lubricating oil.                      These results are compared with theory allowing for                      the relationship of temperature and viscosity.                 </p>	205
	<p>                     Golubev, A.I. Plane Steady Flow of a Viscous Incompressible                      Fluid With a Variable Coefficient of Viscosity in a Bearing                      The author presents a hydrodynamic theory of the                      lubrication of infinitely long bearings taking into                      account the hyperbolic relationship between temperature                      and viscosity.                 </p>	224
	<p>                     Rargin, D.P. Calculating Temperature Distribution Through-                      out a Thin-Bearing Plate of a Hydrogenerator                      The author presents a method for calculating the                      temperature distribution throughout the thin-bear-                      ing plate. According to the author, this method is                      based on a numerical method of finite heat-conduc-                      tion calculation which makes it possible to determine quickly                      temperature distribution in bodies of intricate shape                      and with complex boundary conditions. The method insures                      a sufficient degree of accuracy.                 </p>	242
	<p>                     Korovchinskiy, M.V. Possible Boundary Conditions of                      Hydrodynamic Friction in a Four-Ball Lubricant Testing                      Machine                      The author presents results of theoretical inves-                      tigation of hydrodynamic lubrication regimes.                 </p>	286
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	<p>                     Matveyevskiy, R.M. Friction Conditions in Testing Oils                      in a Four-Ball Machine                      The author presents results of experiments                      conducted to determine the lubricating conditions                      and type of friction existing between ball contacts                      in four-ball testing-machines.                 </p>	295
	<p>                     Lyubarskiy, I.M., A.P. Lyubchenko, and V.G. Mestrenko. On                      the Performance of Sulfurized Lubricants                      Results of an investigation of the performance of a                      sulfurized lubricant containing niger oil with a                      2-3 percent sulfur content are presented.                 </p>	295



LYUBARSKIY, I.M.

AUTHOR: Ginzburg, Z. L.

129-58-5-15/17

TITLE: Scientific-Technical Conference on Metallography and Heat Treatment, Khar'kov (Nauchno-tekhnicheskaya konferentsiya po metallovedeniyu i termicheskoy obrabotke, Khar'kov)

PERIODICAL: Metallovedeniye i Obrabotka Metallov, 1958, Nr 5, pp 53-57 (USSR)

ABSTRACT: The conference was organized by the Khar'kov Directorate of the Scientific-Technical Society of the Engineering Industry jointly with the Sovnarkhoz to celebrate the 40th anniversary of the October Revolution. About 200 research workers, engineers and technicians participated. Candidate of Technical Sciences V.V.Gavranek read a paper on the achievements of Soviet science and engineering in the field of metals technology and heat treatment during the forty years of Soviet rule. Doctor of Technical Sciences, Professor P. P. Petrosyan, Khar'kov Institute of Railway Engineers, read the paper "On the Mechanism of Transformation of Super-cooled Austenite". He expressed the view that all the transformations of super-cooled austenite in the temperature range

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129-58-5-15/17

Scientific-Technical Conference on Metallography and Heat Treatment, Khar'kov

$A_1$ -M can be considered as processes linked with preliminary falling out of carbon from the austenite, which is a necessary condition for the subsequent polymorphous  $\gamma \rightarrow \alpha$  transformation to proceed. There is a qualitative relation between the duration of the incubation period and the transformation mechanism in the entire temperature range  $A_1$ -M.

Candidate of Technical Sciences I. M. Lyubarskiy and Engineer O. M. Podgorna, Khar'kov Works for Building Transport Machinery imeni Malyshev, dealt with the changes in the characteristics of rubbing surfaces. Until recently the problems of wear and friction were not considered from the metallurgical point of view; the first experiments in this respect have shown how fruitful metallurgical investigations of rubbing surfaces can be. During the process of friction important structural and physico-chemical changes take place in the active layer. The nature and the dynamics of the changes during friction of the "white zone" was considered. In this part of the

Card 2/20 paper the influence of the white zone on the operational

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properties of the components was elucidated. Practical experience has shown that most failures are due to fatigue. A very effective method of increasing the stable strength of components is by surface work hardening.

Candidate of Technical Sciences A. A. Novik and Engineer V. I. Muzhikov reported on the work of the Khar'kov Works for Building Transport Machinery in the paper "Surface Work Hardening as an Effective Method of Increasing the Fatigue Strength of Highly Stressed Components". The highest sensitivity to failure was observed in components which contain stress concentrators inherent in the design. Surface work hardening of such components gives better results and is technologically more suitable than shot peening. Work hardening by means of rolls is suitable for components like gears, shafts, etc. Work hardening of friction discs and of cylinder jackets of diesel engines by shot peening proved highly effective.

Card 3/20 In his paper Engineer D. B. Bosko-boynikov dealt with

SOV/126-7-3-39/44

AUTHORS: Palatnik, L. S., Lyubarskiy, I. M. and Boyko, B. T.

TITLE: A Contribution to the Nature of the "White Zone"  
(K voprosu o prirode "beloy zony")  
(A reply to the article "X-Ray Investigation of the Structure  
of Surface Friction" by Kostetskiy et alii (Ref.4) )

PERIODICAL: Fizika metallov i metallovedeniye, Vol 7, Nr 3, pp 473-474  
(USSR) - 1958

ABSTRACT: B. I. Kostetskiy and co-workers (Refs.1 and 2) have expressed the assumption that the "white zone" which forms at the friction surface at certain rates of slip of the rubbing surfaces, consists either of a layer of oxides ("oxidizing wear" according to Kostetskiy's classification), or a secondary quenched structure (thermal wear). Palatnik (Ref.3) did not find iron oxides in the portion of "white zone" which he investigated by X-rays. The authors of this paper have come to the conclusion that Kostetskiy's hypothesis is erroneous. The basic objections of Kostetskiy and his co-workers (Ref.4) in connection with the present authors' Card 1/2 article (Ref.3) are the following: ✓

SOV/125-7-3-39/44

A Contribution to the Nature of the "White Zone"

- (a) In the paper by the present authors (Ref.3) the already well-known fact that the layer formed during thermal wear is a hardening structure has only been confirmed again.
- (b) A white layer which forms in thermal and not in oxidizing wear appears to have been investigated in the paper (Ref.3). It has been shown by the authors of the present paper that the great hardness of the "white zone" (in spite of the great quantity of austenite) is due, not to the absorption of oxygen or nitrogen from without (Ref.5) etc., but to the formation of a definite highly dispersed heterogeneous structure as the product of a solution of carbides and the subsequent very rapid quenching in which dispersed carbides are precipitated.
- There are 5 Soviet references.

SUBMITTED: January 19, 1958

Card 2/2

LYUBARSKIY, I.M.; LYUBCHENKO, A.P.; NESTERENKO, V.G.

Performance of sulfured lubricants. Tren. i izn. mash. no. 121295-  
303 '58. (MIRA 11:8)

(Lubrication and lubricants)  
(Sulfur)

SOV/123-59-16-64534

Translation from: Referativnyy zhurnal. Mashinostroyeniye, 1959, Nr 16, p 125 (USSR)

AUTHORS: Palatnik, L.S., Lyubarskiy, I.M., Lyubchenko, A.P.

TITLE: On Phase Transformations in Cemented Steel Layers

PERIODICAL: Tr. Khar'kovsk. politekhn. in-ta, 1958, 14, 153 - 159

ABSTRACT: The transformation of austenite into martensite and their distribution in the cemented layer of 18KhNVA steel was investigated. The preliminary treatment of the samples: cementation at 910°C during 24 hours with solid carburizing agent, containing 93% of charcoal, and subsequent air-cooling; tempering at 650°C during four hours; oil-hardening at 810°C and tempering at 150°C during 2 hours. Depth of cemented layer  $-1.8 \pm 0.1$  mm. X-ray photos were taken in the chamber with focusing by the Bolin method and in the Debye chamber in iron rays. After cementation to a depth of about 0.5 mm the maximum of residual austenite is formed, the position of which is not changed in the course of the following operations. The general distribution of the residual austenite over the depth of the layer after tempering and hardening with tempering is approximately alike. The surface decarbonization of the cemented layer, the mechanical interaction of the

Card 1/2

On Phase Transformations in Cemented Steel Layers

SOV/123-59-16-64534

latter with the core, the migration of the alloying elements and their re-distribution between austenite and carbides is not the cause of the characteristic distribution of the phases over the depth of the layer and was not confirmed by tests. A diffusion re-distribution of C in the austenite, when cooled slowly, was discovered, which preceded the non-diffusion  $\gamma \rightarrow \alpha$  transformation. The distribution of residual austenite with the maximum is connected with a decrease in resistance of the over-cooled  $\gamma$ -phase at a deviation from the eutectoid concentration of C. 17, references.

B.V.N.

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S/123/59/000/09/20/036  
A002/A001

Translation from: Referativnyy zhurnal, Mashinostroyeniye, 1959, No. 9, p. 109,  
# 33672

AUTHORS: Palatnik, L. S., Lyubarskiy, I. M., Tananko, I. A.

TITLE: On the Carbide Component in the Case-Hardened Layer of "18XHBA"  
(18KhNVA) Steel

PERIODICAL: Tr. Khar'kovsk. politekhn. in-ta, 1958, Vol. 14, pp. 189-193

TEXT: The authors studied the carbide component of the case-hardened layer of 18KhNVA steel after case-hardening at 910-1,000°C and subsequent stages of heat-treatment (two-fold high tempering; high tempering with subsequent oil quenching). The layers of the specimens were electrolytically dissolved and carbide powder was deposited and studied. The investigation was carried out by X-ray analysis using the method of microsections in Fe-radiation. Two carbide phases were detected in the powders: Fe<sub>3</sub>C cementite and (Fe, W, Cr)<sub>23</sub>C<sub>6</sub> composite carbide. The composite carbide contained 50-70% Fe and 7-10% Cr. It has a face-centered cubic lattice with the parameter

✓B

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S/123/59/000/09/20/036  
A002/A001

On the Carbide Component in the Case-Hardened Layer of "18XHEA" (18%NiWVA) Steel

$\alpha = 10.58 \text{ \AA}$  ( $d(422) = 2.16 \text{ \AA}$ ;  $d(600) = 1.244 \text{ \AA}$ ;  $d(15) = 1.218 \text{ \AA}$ ;  $d(844) = 1.08 \text{ \AA}$ ). With increasing distance from the specimen surface, the quantity of cementite decreases, while the quantity of composite carbide increases initially and then decreases after passing through a maximum. At a distance of  $>0.1 \text{ mm}$  from the surface, the quantity of composite carbide exceeds the amount of cementite. There are 3 figures and 6 references.

S. A. G.

Translator's note: This is the full translation of the original Russian abstract.

✓B

Card 2/2

67664

SOV/126-8-6-12/24

18.8200

AUTHORS:

Lyubarskiy, I.M., Lyubchenko, A.P. and Bakakin, G.N.

TITLE:

Resistance to Wear<sup>18</sup> of Case-Hardened Steel<sup>18</sup> and Its Submicrostructure

PERIODICAL:

Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 6, pp 872-877 (USSR)

ABSTRACT:

Lyubarskiy, Lyubchenko et al (Ref 1,2) have suggested that the apparently different effect of residual austenite in the carburized layer on wear resistance is due to differences in submicrostructure. The present authors suggest that other phases should also be considered and give the results of their experimental study of the wear resistance, submicrostructure and degree of alloying of the phases in the carburized layer of steel containing different quantities of residual austenite. A carburized layer in 18 KhNVA steel subjected to various heat treatments (table) was used; wear being determined with the aid of radioactive iron and cobalt. The radioactivity of the lubricant was measured and the autoradiography of the wear products was effected. The submicrostructure of the alpha and gamma phases were established by harmonic analysis of the form of the (211) <sup>18</sup>

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SOV/126-8-6-12/24

Resistance to Wear of Case-Hardened Steel and Its Submicrostructure

and (311) interference lines, respectively (Ref 7). Results are tabulated for specimens heat treated in various ways and before and after wear. The wear and rates of wear are plotted against the logarithm of testing time in Fig 1 for the different conditions. Curves of micronardness against time for two of the conditions are shown in Fig 2. The results show that the cooling conditions after case-hardening affect wear resistance greatly, eg a high resistance with the same residual-austenite content by rapid cooling is obtained. Friction conditions also affect wear resistance and during friction the submicrostructure changes. It has previously been shown (Ref 2) that cooling rate does not influence carbide distribution with respect to depth but does affect the degree of saturation of the carbide phase with alloying elements, particularly chromium, and the authors discuss these factors in relation to the present investigation and the behaviour of different components during wear. Their general conclusions are that the best wear resistance surface can be obtained through a correct assessment of processes occurring in the active layer

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Resistance to Wear of Case-Hardened Steel and Its Submicrostructure

during friction. In the test procedure used (pure sliding of the radioactive specimen over a standard disc, or under conditions resembling gear meshing - Ref 6 - ) high wear-resistance is obtained when there is a considerable residual-austenite content in the carburized layer in which the gamma- and alpha-phase crystals are in the "un-work-hardened" and "work-hardened" states, respectively. Professor L.S.Palatnik contributed valuable advice in this work. There are 2 figures, 1 table and 15 Soviet references.

ASSOCIATION: Zavod transportnogo mashinostroyeniya g. Kharkov  
(Transport Machine Construction Works, Khar'kov)

SUBMITTED: March 9, 1959

Card 3/3

LYUBARSKIY I M.

SOV/5053

PHASE I BOOK EXPLOITATION

Vsesoyuznaya konferentsiya po treniru i iznosu v mashinakh. 3d, 1958.

Izno i iznosostoykost'. Antifrictionnyye materialy (Wear and Wear Resistance. Antifriction Materials) Moscow, Izd-vo AN SSSR, 1960. 273 p. Errata slip inserted. 3,500 copies printed. (Series: Itsa: Trudy, v. 1)

Sponsoring Agency: Akademiya nauk SSSR. Institut mashinovedeniya. Resp. Ed.: M. M. Krushchov, Professor; Eds. of Publishing House: M. Ya. Klebanov, and S. L. Orpik; Tech. Ed.: I. V. Polyakova.

PURPOSE: This collection of articles is intended for practicing engineers and research scientists.

COVERAGE: The collection, published by the Institut mashinovedeniya, AN SSSR (Institute of Science of Machines, Academy of Sciences, USSR) contains papers presented at the III Vsesoyuznaya konferentsiya po treniru i iznosu v mashinakh (Third All-Union Conference on Friction and Wear in Machines) which was held April 9-15, 1958. Problems discussed were in 5 main areas: 1) Hydrodynamic Theory of Lubrication and Friction Bearings (Chairman: V. M. Outyar, Doctor of Technical Sciences, and A. E. Dyubkov, Doctor of Technical Sciences); 2) Lubrication and Lubricant Materials (Chairman: G. V. Vinogradov, Doctor of Chemical Sciences); 3) Dry and Boundary Friction (Chairman: E. V. Derjagin, Corresponding Member of the Academy of Sciences, USSR, and V. Kragel'skiy, Doctor of Technical Sciences); 4) Wear and Wear Resistance (Chairman: M. M. Krushchov, Doctor of Technical Sciences); and 5) Friction and Antifriction Materials (Chairman: I. V. Kragel'skiy, Doctor of Technical Sciences). Chairman of the general assembly (on the first and last day of the conference) was Academician A. A. Blagomayov. L. Yu. Pruzhanskiy, Candidate of Technical Sciences, was scientific secretary. The transactions of the conference were published in 3 volumes, of which the present volume is the first. This volume contains articles concerning the wear and wear resistance of antifriction materials. Among the topics covered are: modern developments in the theory and experimental science of wear resistance of materials, specific data on the wear resistance of various combinations of materials, methods for increasing the wear resistance of certain materials, the effects of friction and wear on the structure of materials, the mechanism of the sealing of metals, the effect of various types of lubricating materials on sealing, abrasive wear of a wide variety of materials and components under many different conditions, modern developments in antifriction materials, and the effects of finish machining on wear resistance. Many personalities are mentioned in the text. References accompany most of the articles.

Menkov, P. P. Increasing the Wear Resistance of Cast-Iron Machine Components by Means of Isothermal Hardening	42
Palatnik, L. S., I. M. Lyubarskiy, and A. P. Krubchenko. Some Problems in the Physics of Metal Wear	46
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Savitskiy, K. V. On the Laws of Plastic Deformation in the Case of Friction of Metals	70
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PHASE I BOOK EXPLOITATION

SOV/5053

Vsesoyuznaya konferentsiya po treniyu i iznosu v mashinakh. 3d, 1958.

Iznos i iznosostoykost'. Antifrictionnnyye materialy (Wear and Wear Resistance: Antifriction Materials) Moscow, Izd-vo AN SSSR, 1960. 273 p. Izd-vo all inserted. 3,500 copies printed. (Series: Iti: Trudy, V. 1)

Sponsoring Agency: Akademiya nauk SSSR. Institut mashinovedeniya. Resp. Ed.: M. M. Khrushchov, Professor; Eds. of Publishing House: M. Ya. Klebanov, and S. L. Orlik; Tech. Ed.: T. V. Polyakova.

PURPOSE: This collection of articles is intended for practicing engineers and research scientists.

COVERAGE: The collection, published by the Institut mashinovedeniya, AN SSSR (Institute of Science of Machines, Academy of Sciences SSSR) contains papers presented at the III Vsesoyuznaya konferentsiya po treniyu i iznosu v mashinakh (Third All-Union Conference on Friction and Wear in Machines) which was held April 9-15, 1958. Problems discussed were in 5 main areas: 1) Hydrodynamic Theory of Lubrication and Friction Bearings (Chairman: Ye. M. Gut'yar, Doctor of Technical Sciences, and A. K. Pivovarov, Doctor of Technical Sciences); 2) Lubrication of Frictional Materials (Chairman: O. V. Vinogradov, Doctor of Chemical Sciences); 3) Dry and Boundary Friction (Chairman: A. V. Derjagin, Corresponding Member of the Academy of Sciences SSSR, and I. V. Kragel'skiy, Doctor of Technical Sciences); 4) Wear and Wear Resistance (Chairman: M. M. Khrushchov, Doctor of Technical Sciences); and 5) Friction and Antifriction Materials (Chairman: I. V. Kragel'skiy, Doctor of Technical Sciences). Chairman of the general assembly (on the last day of the conference) was Academician A. A. Maslennikov. L. Yu. Kruzhanskiy, Candidate of Technical Sciences, was scientific secretary. The transactions of the conference were published in 3 volumes, of which the present volume is the first. This volume contains articles concerning the wear and wear resistance of antifriction materials. Among the topics covered are: modern developments in the theory and experimental science of wear resistance of materials, specific data on the wear resistance of various combinations of materials, methods for increasing the wear resistance of certain materials, the effects of friction and wear on the structure of materials, the mechanism of the seizing of metal, the effect of various types of lubricating materials on seizing, abrasive wear of a wide variety of materials and components under various conditions, modern developments in antifriction materials, and the effects of finish machining on wear resistance. Many personalities are mentioned in the text. References accompany most of the articles.

Corb. M. L. X-Ray Investigation of the Structure of Steel Deformed by Nonuniform Volumetric Compression at Normal and Elevated Temperatures	128
Izheles, P. Ya., and V. I. Staritskiy. On the Stresses and Structural Transformations in Steel Due to Wear	135
Klikova, E. P. Gripping of Metals Under Ordinary Conditions and the Action of Normal Loads	144
Kostetskiy, B. I., P. K. Topol'skiy, and I. O. Mosovskiy. Secondary Structures on Friction Surfaces, and the Wear of Metals	152
Leubarskiy, I. M., M. P. Zaslavskiy, D. B. Voskobornikov, and M. K. Pivovarov. Dynamics of Structural Transformations in the Case of Wear	163

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LYUBARSKIY, I. M., LYUBCHENKO, A. P., AND GERASIMENKO, K. S.

On the Effect of the Thin Sulfide Film Which Forms Over the Friction Surface During the Process of Wear on the Wear-Resistance of Steel

Povysheniye iznosostoykosti i sroka sluzhby mashin. t. 2 (Increasing the Wear Resistance and Extending the Service Life of Machines. v. 2) Kiyev, Izd-vo AN UkrSSR, 1960  
290 p. 3,000 copies printed. (Series: Its: Trudy, t. 2)

Sponsoring Agency: Vsesoyuznoye nauchno-tekhnicheskoye obshchestvo mashinostroyitel'noy promyshlennosti. Tsentral'noye i Kiyevskoye oblastnoye pravleniye. Institut mekhaniki AN UkrSSR.

Editorial Board: Resp. Ed.: B. D. Grozin; Deputy Resp. Ed.: D. A. Draygor; M. P. Braun, I. D. Faynerman, I. V. Kragel'skiy; Scientific Secretary: M. L. Barabash; ED. of v. 2: Ya. A. Samokhvalov; Tech. Ed.: N. P. Rakhlina.

COVERAGE: The collection contains papers presented at the Third Scientific Technical Conference held in Kiyev in September 1957 on problems of increasing the wear resistance and extending the service life of machines. The conference was sponsored by the Institut stroitel'noy mekhaniki AN UkrSSR (Institute of Structural Mechanics of the Academy of Sciences Ukrainian SSR), and by the Kiyevskaya oblastnaya organizatsiya nauchno-tekhnicheskogo obshchestva mashinostroyitel'noy promyshlennosti (Kiyev Regional Organization of the Scientific Technical Society of the Machine-Building Industry).



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78126  
SOV/129-60-3-5/16

AUTHORS: Lyubarskiy, I. M., Lyubchenko, A. P., Gerasimenko,  
K. S. (Engineers)

TITLE: Structure and Wear Resistance of Steel Surfaces After  
Parkerizing

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov,  
1960, Nr 3, pp 18-21 (USSR)

ABSTRACT: This is a report concerning experimental tests of  
steel 18KhNVA, to which some small admixtures of  
radioisotope Co<sup>60</sup><sub>27</sub> were added during smelting. The  
samples were heat-treated by various methods. After  
heat treatment and parkerizing, the samples (15 mm  
diameter, 9 mm high) were tested under the conditions  
of pure sliding and abundance of lubrication on  
friction test machine shown in Fig. 1.

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Structure and Wear Resistance of Steel  
Surfaces After Parkerizing

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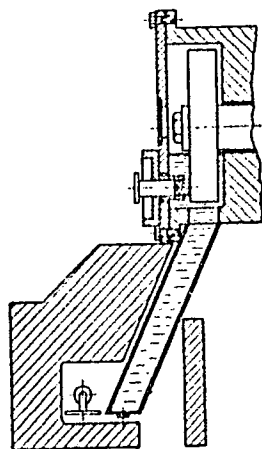


Fig. 1. Diagram of a  
machine for wear-testing  
of samples.

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Structure and Wear Resistance of Steel  
Surfaces After Parkerizing

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The speed of sliding equalled 1.7 m/sec and specific pressure was 0.3 kg/mm<sup>2</sup>. The flat surface of friction disk and the samples were ground. After each test the disk was replaced. The degree of wear was judged by the integral radioactivity of oil measured by MS-4 meter and B-2 radiometer. The authors arrived at the following conclusions. (1) Parkerizing increases total wear resistance of friction surface, which is determined by the amount of products of wear passed into lubrication and were transferred upon conjugated surface. The lower is the material's hardness the higher is the effect of parkerizing. (2) The increased wear resistance of the surface after parkerizing is the result of a change in physicochemical properties of friction surface, which decreases the tendency of material to "seizing" in the point of contact.

There are 4 figures; 1 table; and 4 Soviet references.

Card 3/3

LYUBARSKIY, L.M.

PHASE I BOOK EXPLOITATION SOV/5458

Girshovich, Naum Grigor'yevich, Doctor of Technical Sciences, Professor, ed.

Spravochnik po chugunnomu lit'yu (Handbook on Iron Castings) 2d ed., rev. and enl. Moscow, Mashgiz, 1961. 800 p. Errata slip inserted. 16,000 copies printed.

Reviewer: P. P. Berg, Doctor of Technical Sciences, Professor; Ed.: I. A. Baranov, Engineer; Ed. of Publishing House: T. L. Leykina; Tech. Eds.: O. V. Speranskaya and P. S. Frumkin; Managing Ed. for Literature on Machine-Building Technology (Leningrad Department, Mashgiz): Ye. P. Naumov, Engineer.

PURPOSE: This handbook is intended for technical personnel at cast-iron foundries. It may also be of use to skilled workmen in foundries and students specializing in founding.

COVERAGE: The handbook contains information on basic problems in the modern manufacture of iron castings. The following are discussed: the composition and properties of the metal; the making of molds; special casting methods; the charge preparation; melting

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